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Christiaan Huygens: The Discovery and Doctrine of a Mathematician

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Abstract

This paper examines the life of Christiaan Huygens, a Dutch Mathematician born in 1629. Through this examination of his life, I discuss his training, a few of his colleagues, and his major mathematical discoveries. These major discoveries include Saturn's rings, the pendulum clock, and the Wave Theory of Light. The paper then moves into Huygens's faith and the effect that this had on his work. Knowing the faith of this mathematician gives us some insight on his motivations and beliefs behind his work. Through research, I was able to find some information on how his beliefs brought about his theories; however, Huygens wasn't very open with his religious perspective. Finally, I address how my faith and study of mathematics will affect my future endeavors in life and teaching.

Christiaan Huygens: The Discoveries and Doctrine of a Mathematician

While there are many mathematical and scientific geniuses that have affected our understanding of the world, Christiaan Huygens is one whose name may not receive the credit that it is due. Some may have never heard his name before, but Huygens provided us with several advancements and discoveries that have affected how we view our world today. He helped to advance the telescope and, from this, discovered Saturn's largest moon (Titan) and Saturn's rings. He studied the physics of pendulums and invented the pendulum clock, and he also created the Wave Theory of Light that we accept and use today. These discoveries and intellectual achievements are only a few of the things that he contributed to our society. During his exploration of mathematics and science, Huygens continued in his pursuit of Christian beliefs. In Book II of his *Cosmotheoros*, he marvels:

> What a wonderful and amazing Scheme have we here of the magnificent Vastness of the Universe! So many Suns, so many Earths, and every one of them stock'd with so many Herbs, Trees and Animals, and adorn'd with so many Seas and Mountains! And how must our wonder and admiration be encreased when we consider the prodigious distance and multitude of the Stars? (150-151).

As he used his love for learning to achieve his goals and accomplish much in the scientific and mathematical communities, he also had a love for God and His creations that continued his drive to make mathematical and scientific discoveries about our world.

Christiaan Huygens was born on April 14, 1629 in The Hague, Netherlands, and has been deemed one of the greatest scientists of the seventeenth century (Cajori 182). He was the son of Constantijn Huygens, a diplomat and poet (Herivel). Constantijn was friends with Rene Descartes, a well-known philosopher and mathematician ("Christaan Huygens"), who predicted

Christiaan's future success (Cajori 182). At an early age, his father began to tutor him and his older brother; at age 16, Huygens went on to receive further training at Leyden under Frans Van Schooten ("Christiaan Huygens"). Two years later, Huygens entered the college of Breda, which occurred "in the midst of a furious controversy over the philosophy of Descartes" (Herivel).

One of Huygens's earliest contributions to the mathematical world was a treatise that pointed out the misconceptions of Gregory St. Vincent's ideas about the quadrature of a circle. He also gave a very close approximation to the length of a circular arc (Cajori 182). In 1665, Huygens travelled to Paris where he made his entrance into the elite intellectual world. He was appointed by Louis XIV to be a member of the French Academy of Sciences (Cajori 182). He remained in Paris until 1681, when he was forced to return to his home city due to the Edict of Nantes. This edict outlawed Protestantism, which was a very important part of Huygens's life (Cajori 182). Other than the few facts listed above, there is not much else known about his early life and training. Despite not knowing these facts, one can assume they were major players in his later mathematical accomplishments.

While in Paris, Huygens gained a reputation in Europe with his mathematical publications and his discovery of the true shape of Saturn's rings in 1659. His studies of mathematics included hydrostatics, impact and collision, and the law of conservation of momentum ("Huygens, Christiaan"). He also studied centrifugal force and in 1659 was able to show it's similarity to gravitational force, however he lacked the "Newtonian concept of acceleration" ("Huygens, Christiaan). His studies then expanded more into scientific research. His advancement of the telescope helped lead to the discovery of Saturn's rings. About five years before, Huygens found a more efficient way to grind and polish lenses. His study of geometric optics led to him creating a specific eyepiece for the telescope that reduced chromatic aberration

("Huygens, Christiaan"), and in 1655, using one of his own lenses, he discovered Titan, the first moon of Saturn (O'Conner and Robertson). He began to spread his discovery in Paris and, because of this, began corresponding with Pascal and Fermat about their work in probability (O'Conner and Robertson). In the year after, Huygens discovered the true shape of Saturn's rings. In his work *Systena Saturnium* (1659) he explained the phases of the rings. However, there were many, such as Boulliau and Fabri, who disagreed with these observations, but by 1665, even these were compelled to accept his theories because of the advancement of telescopes (O'Conner and Robertson). The study of astronomy gave Huygens a need for accurate time keeping, which led to his further interest in the subject of time (O'Conner and Robertson).

Huygens's invention of the pendulum clock began with his study of the "tractrix, the logarithmic curve, the catenary, and [he] established the cycloid as a tautochronous curve" (Struik 142). This establishment of the cycloid helped his development of the cycloidal pendulum. He derived the relationship of "the period T of a simple pendulum to its length l as: $T = 2\pi\sqrt{(l/g)}$" ("Huygens, Christiaan). According to O'Conner and Robertson, Huygens "derived the law of centrifugal force for uniform circular motion," and "as a result of this, Huygens, Hooke, Halley, and Wren formulated the inverse-square law of gravitational attraction." Huygens's exploration of the pendulum and circular motion brought some recognition to his name; however, his study of the wave theory of light is what brought him the majority of his recognition.

Huygens's wave theory of light was in direct opposition to Newton's corpuscular theory (Motz and Weaver 177). This theory became so well known that it bares his name: the Huygens principle. This principle states, "every point on the surface of an advancing wave is the source of new wavelets, which then form the new surface of the advancing wave. Thus each wave surface

renews itself so that the wave advances" (Motz and Weaver 177). By studying light waves through small apertures, Huygens was able to show through mathematics that his theory explained "observed phenomena such as optical interference and optical diffraction," which Newton's corpuscular theory couldn't explain (Motz and Weaver 177). In *Traité de la lumière,* Huygens explained reflection and refraction and was able to show that refraction "is related to differing velocities of light in media" ("Huygens, Christiaan"). This theory that somewhat contradicted Newton's theory gained Huygens his recognition.

While pursuing mathematical and scientific studies for this recognition, Huygens also perused a relationship with Christ. In his book *Cosmotheoros* (1698), Huygens stated:

> I suppose no body will deny but that there's somewhat more of Contrivance, somewhat more of Miracle in the production and growth of Plants and Animals, than in lifeless heaps of inanimate Bodies, be they never so much larger; as Mountains, Rocks, or Seas are. For the finger of God, and the Wisdom of Divine Providence, is in them much more clearly manifested than in the other. One of Democritus's or [de]Cartes's Scholars may venture perhaps to give some tolerable Explication of the appearances in Heaven and Earth, allow him but his Atoms and Motion; but when he comes to Plants and Animals, he'll find himself non-plus'd, and give you no likely account of their Production. For every thing in them is so exactly adapted to some design, every part of them so fitted to its proper life, that they manifest an Infinite Wisdom, and exquisite Knowlege in the Laws of Nature and Geometry, as, to omit those Wonders in Generation, we shall by and by show; and make it an absurdity even to think of their being thus haply jumbled together by a chance Motion of I don't know what little Particles.

Huygens firmly believed in the God's creation of the universe, and this led to his fascination with how it worked.

Huygens was born to Protestant Christian parents and maintained these beliefs through his life. However, according to David Coppedge, Huygens didn't speak out much about his religion. There is not much known about Huygens beliefs other than that he was amazed by creation and the God who created it. Some historians want to place him in the "Parisian agnostic rationalist tradition because of his associations with the Paris Academy" (Coppedge). But according to A. E. Bell, "the evidence rather shows, on the contrary, that he continued to support Protestantism up to the end of his life" (202). Huygens stayed strong in his protestant beliefs despite all of the major beliefs at the time. His view on design and creation explained in *Cosmotheoros* came at the end of his life, which shows that his beliefs persevered throughout his lifetime. His position was "his personal, rational choice, and he supported it with informed arguments using logic, science and scripture" (Coppedge).

Cosmotheoros is a book written by Huygens that focuses on the likelihood of life on other planets and how this speculation does not contradict the Bible (Coppedge). This belief of life on other planets that walk up right, have houses, and so on seems crazy in today's modern world. However, at the time, he was doing the best he could with the technology and scientific knowledge that he had (Coppedge). As testament to his faith, Huygens never stated that this life occurred of itself; he believed that there was a Creator that created all life and our universe as seen in the quotes previously referenced. Huygens scientific interests and studies represented his passion to uncover the many wonders of our world created by our God. He constantly pursued math, science, and God with his whole heart, mind, and life. Because of this, we have been able to discover a little more about our universe around us.

As a mathematician myself, I hope to be able to pursue learning and God as well as Christiaan Huygens did. Being able to learn about the world around us gives us more (although small) glimpses of the amazing God who is our Creator. The more I learn about the world, the more I want to learn about God. And the more I learn about God, the more I want to learn about His world. This continual pursuit to learn about the world and God has led me to want to teach this to others as well.

As a future math teacher, I hope to be able to teach my students the importance of learning mathematical and scientific concepts. These concepts give us a broader view of the world and let us understand why the world is the way it is. I also hope to be able to show my students God's love, even though I can't explicitly teach them about it. My desire is that my love for my students, for learning, and for teaching will help them to see God's love through me. Math has always been one of my favorite concepts to study. The pathways, discoveries, and problems are endless. Christiaan Huygens, through his solid belief in God, was able to make some mathematical discoveries that changed the way we see the world, and I hope that as I teach these concepts to my students, they will be able to realize that the world was created to be so much more than just where we live.

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